Higg's Jet and Met Resolution Task Force

Not intended to replace the JES/R group, add resources to efforts and tailor corrections for Higgs searches.

Build on work already done and renew interest in existing efforts

Task Force Coordinators: Ben Kilminster bjk@fnal.gov
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- Collect information on web:
http://www-cdf.fnal.gov/internal/physics/HiggsJetMet/

- Use existing Higgs email for communication:
cdf_higgs@fnal.gov

- Use Wed (Higgs Task Force) time slot for working meetings
Wednesdays 10 am - 12 pm, *every other week*

- Work together with existing JES/R group and present summary/results in HDG

- Had a kick-off meeting April 25th *Was very well attended...*

Goals

- Develop/identify "general" techniques to improve the Jet and Missing Et resolution that are applicable to Higgs analyses
- Quantify improvements and the impact on existing measurements
- Provide web based documentation, tutorials and example code
- Provide standard reference samples to test performance
- Provide/document user interface to the correction utilities
- Short term: improvements which can be made to existing Gen 6 analysis
- Long term: improvements applicable to Gen 7 + full data set

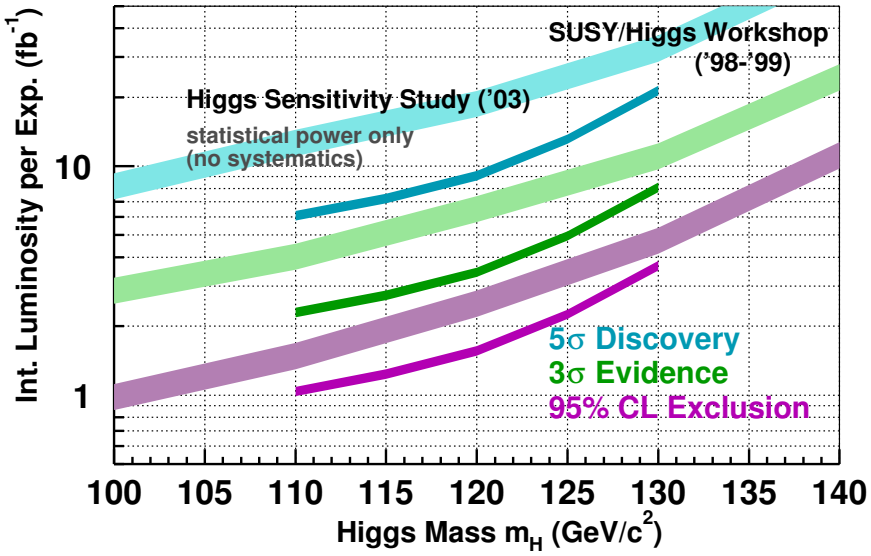
- Summarize expected improvements and improvements for the short term (2007 conferences) in a CDF Note

- Update note and outline improvements for the full data set

Motivation

- Updated sensitivity plot was made assuming a 10% dijet mass resolution...

- 1% narrowing of the signal di-jet resolution improves signal to background separation



→ Up to a 10% effective increase in luminosity when using Mjj as a discriminant

Where we are:

Higgs Mass	CDF Current Limit/SM	Expected	Combined with DØ
115 GeV	11.3	8.0	~ 5
160 GeV	3.1	4.9	~ 3

Need:

25× more data at low mass

10× more data at high mass

Run longer or work smarter...

- One of the improvements that leads to the largest gain...

Improvement factors in terms of luminosity

Improvement	$WH \to l\nu bb$	$ZH \to \nu\nu bb$	$ZH \to llbb$
NN selection	1.75	1.75	1.0
Mass resolution	1.7	1.7	1.7
Continuous b-tag (NN)	1.5	1.5	1.5
Forward leptons	1.3	1.0	1.6
track only leptons	1.4	1.0	1.0
Forward b-tag	1.1	1.1	1.1
WH signal in ZH	1.0	2.7	1.0
Product of above	8.9	13.3	7.2
CDF/DØ combination	2.0	2.0	2.0
All combined	17.8	26.6	14.4

From Tom's list of improvements...

$\to$ Applying all improvements puts us in the right ball park...

Current Baseline

Jets

Jetclu on EM+HAD towers, cone 0.4, correct to L4, L5, or L7

b tagged jets corrected same as light jets

MET

Sum up EM+HAD towers, correct for primary vertex, correct for muons, correct for jets

Stand back to see what we would do if starting from scratch...

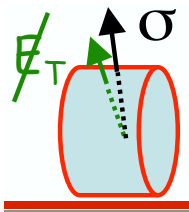
Are we using the "best" jet reconstruction algorithm

Are we using making use of all available information

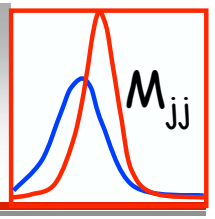
Missing detector simulation

Studies to quantify some of the answers...

How much effort is it worth to invest in order to discover the Higgs?



Areas of Improvement



In blue is what we currently use

Other detectors:

photons & b -> ev+X
preshower, showermax
CES, CPR, PES, PPR
crack energy CCR

Cone Size :

dR < **0.4**, 0.7, 1.0

Cone Algorithm :

Jetclu, Midpoint, Kt, Seedless
"dark towers", "fat jets"

Muons:

punchthrough

b -> μν+x

SVX :

Lxy ~ b jet energy
vtx mass ~ b jet mass
sum Pt tracks
tracks

Calorimeter :

Em + Had
EM fraction
Jet Mass

COT :

Sum Pt tracks
tracks
ID :
charged pions, kaons
protons, muons

Is Everything we need in Ntuple?

σ, σ dependency

different calorimeters
different tracking
cracks

Strategy

Provide documentation and tutorials on web page

Started with a skeleton that needs to be filled in...

One of the best ways to learn something is by teaching it to others...

→ If you want to help out with filling some of the missing information on the web page please contact us...

→ You do not need to be an expert, but willing to learn...

Make the corrections easy to use...

Want to collect enough information so that people can easily apply correction and generate before and after Mjj plots

Summarize status of current correction procedures and collect documentation

H1 (Calorimeter jets + tracks - see Andy Mehta's talk)
NN (Neural Net jet b-specific corrections - see Brandon's talk)
PFA (Particle Flow Algorithm - see Anton's talk)

Combining output from H1 or PFA with NN

Analysis specific corrections

Sent survey to authors asking about:
Status, performance, future plans and resources needed...

Document/specify user interface to correction algorithms

Provide a quantitative comparison of algorithms

Establish baseline: Mjj at parton/hadron level...

Provide Data/MC samples for apples-to-apples comparisons

Specify selection criteria, detector η range

For existing correction algorithms, identify areas where we will get the greatest gain and solicit help

Apply correction to existing analysis

Work closely with an analysis to apply correction as a "proof of existence"

Propagate systematic errors

For the longer term...

Identify information needed to apply the correction

CES/CPR simulation
$\rightarrow$ Need to quantify expected inprovement...

Better shower profile in Gen7

Tower information in STNtuple, not in TOPNtuple

Tracking information needed to apply correction...

Need better forward tracking...

Short Term Goals:

What is available now:

Working with Gen6

→ *H1*
→ *NN*
→ *NN + H1*

Retune/optimize on latest MC samples

Long Term Goals:

→ *Develop PFA*

Working with Gen7

→ *Provides better tracking in the forward region*
→ *Improved shower shape*

Retune/optimize on new MC samples

Ntuple Issues

NN corrections *can* be made with TOPNtuples

STNtuple (not TOPNtuple) has additional information needed to apply the H1 and PFA corrections (Calorimeter Tower information)

Top group has Alpgen backgrounds (Higgs background) available in TOPNtuple (not STNtuples)

New corrections may be offered first with STNtuple, and may require additional work to get added into the TOPNtuples.

Fastest way to get improvement in Mjj is likely with STNtuples

Should also make sure STNtuples are created for background samples

Where you can help...

Fill in some of the missing documentation/tutorials

Validate correction procedure on reference Data/MC files

Generate reference and comparison plots

Extend studies...

Will put together a task list detailing how one can help directly with the correction algorithms *once we get back the results from the survey*